SIEMENS

ARCADIS Avantic

SP

Quality Assurance

System

Image Quality Quick Test

SW Version VB13

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Document revision level

The document corresponds to the version/revision level effective at the time of system delivery. Revisions to hardcopy documentation are not automatically distributed.

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Notes and symbols

The signal words are used and classified in anticipation of the new Medical Solutions CS standard which is based on ANSI standard Z535.4.

Text emphasized in technical documentation has the following meaning:

Tab. 1 GEFAHR / DANGER

	Bei einer unmittelbar drohenden Gefahr, die bei Nichtvermeidung zum Tod oder zu einer schweren Körperverletzung **führt**.
	Indicates when there is an immediate danger that **leads** to death or serious physical injury.

Tab. 2 WARNUNG / WARNING

	Bei einer Gefahr, die bei Nichtvermeidung zum Tod oder zu einer schweren Körperverletzung **führen kann**.
	Indicates a risk of danger that **may lead** to death or serious physical injury.

Tab. 3 VORSICHT / CAUTION

	Bei einer Gefahr, die bei Nichtvermeidung zu einer leichten oder mittleren Körperverletzung und/ oder zu einer Sachbeschädigung führt oder führen kann.
	Indicates a risk of danger that leads to slight or moderate physical injury and/or damage to property.

Tab. 4 ACHTUNG / NOTICE

	Bei einer Gefahr, die bei Nichtvermeidung zu einem unerwünschten Ergebnis oder Zustand führt oder führen kann (**nicht** Tod, Körperverletzung oder Sachbeschädigung).
	Indicates a risk of danger that if disregarded leads or may lead to a potential situation which may result in an undesirable result or state (**not** death, physical injury or property damage).

Tab. 5 HINWEIS / NOTE

HINWEIS	Ist als Tipp zu verstehen. Der Anwender muss diese Anweisung nicht unbedingt beachten. Er erfährt jedoch Vorteile, wenn er dies tut.
NOTE	Should be understood as a tip. The user does not absolutely have to observe these instructions. However, there will be advantages if he does.

General safety information (in existing documents)

⚠WARNING

Danger of injuries, death or material damage.

Non-compliance can lead to death, injury or material damage.

Please note:

- ➪ **The product-specific safety information in the start-up instructions and system service documentation**
- ➪ **The general safety information in TD00-000.860.01... and**
- ➪ **The safety information in accordance with ARTD Part 2.**

System identification

Material no.: _____ Serial no.: _____
Customer/clinic: _____
Address: _____ City: _____
State/province: _____ Country: _____
Phone no.: _____ Contact person: _____
System no.: _____ Office: _____
Responsible system engineer: _____

Image quality acceptance in the factory performed completely and documented by:

Name (block letters): _____ Dept.: _____
Signature: _____ Date: _____

Customer installation date: _____

IQ quick test performed at:

Handover to customer ❒ During maintenance ❒

Settings deviating from the standard based on:

Country-specific regulations ❒ Spec. customer wishes ❒

Reason _____
_____

Name (block letters): _____ Office: _____

Signature: _____

Required measuring equipment and tools

• Set of X-ray filters, 10 x 0.3 mm Cu		44 06 120 RV090
• Precision X-ray filter, 2.1 mm Cu		99 00 598 XE999
• 25 mm AL measuring stand, type 26765 acc. to DIN 6868 Part 50		
or 1.2 mm Cu from the X-ray filter set 17 µm Cu strips		97 98 596 G5321 and 11 67 662 G5247
• Resolution test set type 41		28 71 820 RE999
• Densitometer	e.g. X-Rite 331	97 02 416 Y1996
	or PTW-BC21 including black check	
	Type 5321 and light box type 53213	
• Dynamic test case		37 90 156 X1963
	or	97 50 001 X1963
containing:	TV dynamic test	37 90 164 X1963
	Heart contour diaphragm	37 90 172 X1963
	Capillary test	37 90 180 X1963
	Bracket	87 13 901 X1963
	Veiling glare test	87 09 743 X1963
• SMfit Spotmeter		77 52 848

Requirements

Basic measuring conditions

- Completely functioning system; ensure that
  - the grid is attached to the I.I. input,
  - Tube assembly with collimator and 2.1 mm Cu are installed.
- A "mid" level fluoro dose rate means: (full format; setting tolerance +/- 10%)

33 cm I.I.:	0.131 μGy/s - fluoro (at the I.I. input), grid factor 1.5 must be used.

- A "high" level fluoro dose rate means: (full format; setting tolerance +/- 10%)

33 cm I.I.:	0.262 μGy/s - fluoro (at the I.I. input), grid factor 1.5 must be used.

- In addition, dose multipliers predefined in the unit are used for the different operating modes.
- The setpoints listed in the following chapters apply for a "mid" or "high" dose level; in the case of deviating settings, setpoints may have to be adapted.
- When requested to switch
  - Noise reduction K-factor
  - Edge
  - Motion detection
  - Fluoroscopic characteristic
  - or other parameters in the organ programs, select or change a correspondingly predefined organ program or, if possible, change the parameter directly in the acquisition task card.
- The "Service_X_..." exam sets in "General, All Body Region" must be activated in the ExamSet Editor prior to starting work and returned to the hidden pool after completion of the work. See the following paragraph "Loading/unloading the exam sets relevant for the IQ test"

Activating, deactivating, and selecting the exam sets relevant for the IQ test

NOTE

Exam sets relevant for the IQ test have been predefined to simplify image quality testing and can be loaded.

During normal operation, these are not active and are not visible to the customer.

The exam sets relevant for the IQ test must be activated prior to conducting the image quality test.

These exam sets must then be deactivated after completion of the IQ test.

Activating the exam sets relevant for the IQ test

- Select the "Options" - "Configuration" menu after system start-up.
  - ➪ The "syngo configuration panel" window is displayed.
- Double-click on the "Examination set configuration" icon.
  - ➪ The "Examination set configuration" window is displayed.
- Select the "General" task card in the "Examination set configuration" window.

NOTE

For the exam sets relevant for the IQ test to be visible, no patient region may be selected in the graphic, virtual patient anatomy representation.

If a patient region is selected and is displayed lighter than its surroundings, click once in the gray field to the left or right outside of the image.

This deselects the previously selected patient region and it is no longer displayed lighter than its surroundings.

- All available exam sets are displayed in the "Examination set pool" field in the "Examination set configuration" window.
  - ➪ Already active exam sets have a light background.
  - ➪ Inactive exam sets have a gray background.
- Select each exam set, beginning with "SERVICE_.....", and copy it to the "Active examination sets" field by clicking on the button with the down arrow.
  - ➪ All exam sets, beginning with "SERVICE_...", are displayed in the "Active examination sets" field.
- Click on the "Apply" button.
- Click on the "OK" button.
  - ➪ The "Examination set configuration" window closes.
  - ➪ The exam sets relevant for the IQ test can be selected in the examination task card after a patient is opened under "General".

Deactivating the exam sets relevant for the IQ test

- Select the "Options" - "Configuration" menu after system start-up.
  - ➪ The "syngo configuration panel" window is displayed.
- Double-click on the "Examination set configuration" icon.
  - ➪ The "Examination set configuration" window is displayed.
- Select the "General" task card in the "Examination set configuration" window.

NOTE

For the exam sets relevant for the IQ test to be visible, no patient region may be selected in the graphic, virtual patient anatomy representation.

If a patient region is selected and is displayed lighter than its surroundings, click once in the gray field to the left or right outside of the image.

This deselects the previously selected patient region and it is no longer displayed lighter than its surroundings.

- All available exam sets are displayed in the "Active examination sets" field in the "Examination set configuration" window. Active exam sets have a light background.
- Select each exam set, beginning with "SERVICE_.....", and remove it from the "Active examination sets" field by clicking on the button with the up arrow.
  - ➪ None of the exam sets, beginning with "SERVICE_...", are displayed any longer in the "Active examination sets" field.
- Click on the "Apply" button.
- Click on the "OK" button.
  - ➪ The "Examination set configuration" window closes.
  - ➪ The exam sets relevant for the IQ test are no longer available in the examination task card after a patient is opened under "General".

Selecting the exam sets relevant for the IQ test in the examination task card

- After system start-up, perform a patient registration for the IQ test.
- After loading, the exam sets relevant for the IQ test can be selected in the examination task card.
- Select "General" in the list field above the graphic, virtual patient anatomy representation.
- The exam sets relevant for the IQ test (beginning with "SERVICE_....") can then be selected in the list field below the graphic, virtual patient anatomy representation.

Loading the ASPIA test images relevant for the IQ test

NOTE

The ASPIA test images relevant for the IQ test are not selectable during normal system operation.

To load the images, the local service must be open.

- Call up the local service on the system ("Options" - "Service" - "Local service" menu) and enter the password.
- Leave the local service open during use of the necessary test images.
- Open the patient browser.

  ⇨ The available test images are saved and retrievable under the following path: "Patient" - "Patient list" - "Local database" - "Service patient" - "Test images".
- If the test images are no longer needed, close the open test images and terminate the local service.

Avantic tableside control (overview)

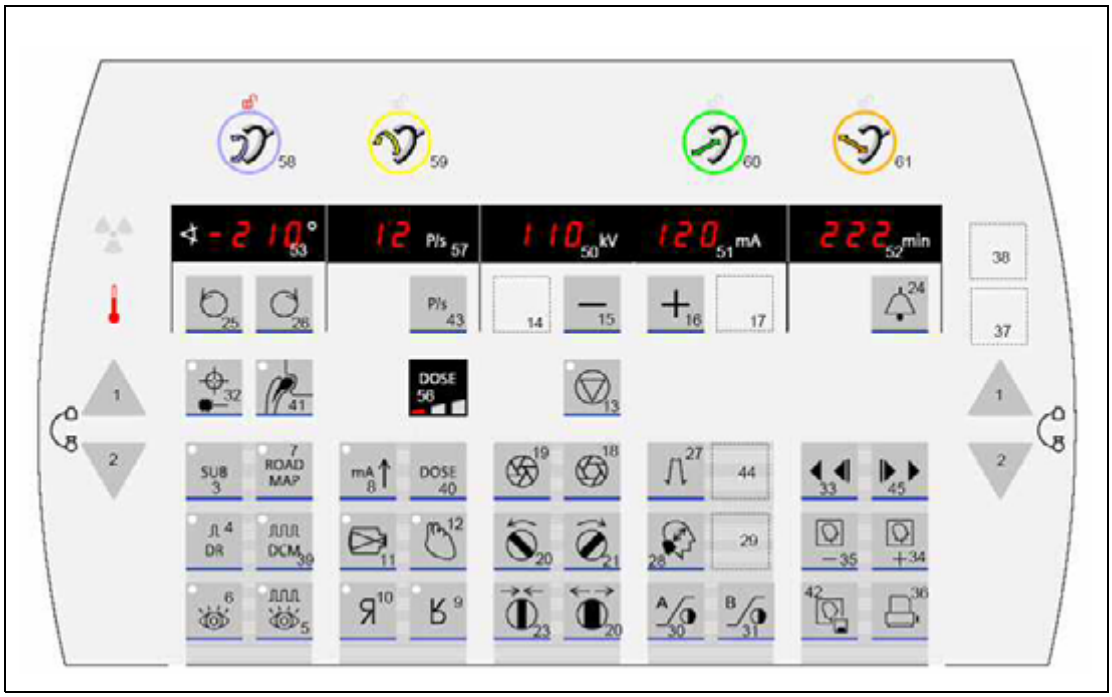

Fig. 1: Overview of button assignment on the control panel

Control panel buttons:

Button no.	Function
1	Move each column up two times
2	Move each column down two times
3	Subtraction mode "SUB"
4	Digital radiography mode "DR"
5	Pulsed fluoroscopy mode "pulsed FLUORO"
6	Fluoroscopy mode "FLUORO"
7	Roadmap mode
8	Push button
9	Top/bottom image reversal (vertical)
10	Left/right image reversal (horizontal)
11	Image intensifier zoom
12	Noise reduction (K-factor selection)
13	kV regulation stop
14	Reserve 1
15	kV/mA adjustment (-)
16	kV/mA adjustment (+)
17	Reserve 2
18	Open X iris diaphragm
19	Close X iris diaphragm
20	Rotate filter diaphragms CCW
21	Rotate filter diaphragms CW
22	Open filter diaphragm
23	Close filter diaphragm
24	Reset fluoro buzzer; set fluoro clock to zero
25	Left image token
26	Right image token
27	Edge enhancement
28	Electronic zoom in the memory
29	Reserve 3
30	Look-up-table for Monitor A
31	Look-up-table for Monitor B

32	Laser
33	Scene backward/stop
34	Scroll forward in the image memory
35	Scroll backward in the image memory
36	Initiate the documentation unit
37	n.a.
38	n.a.
39	DCM mode
40	Dose button
41	Metal button
42	Save image
43	Pulses per second
44	Reserve 4
45	Scene forward/stop

Brake control buttons

No.	Function
58	Orbital C-arm brake
59	Angular C-arm brake
60	Horizontal C-arm brake
61	Swivel C-arm brake

Monitors present

- Check off the monitor present (color monitor or monochrome monitor).
- Check off the manufacturer of the monitor.
- Enter the monitor type according to the type label of the manufacturer in the "type" field.

Color monitors ❒ present

Manufacturer	Eizo ❒ Yes	SIEMENS ❒ Yes
Type	.....	.....

Monochrome monitors ❒ present

Manufacturer	Barco ❒ Yes
Type	.....

Monitor brightness

- Load the SMPTE calibration test image (ASPIA test images).
- Measure the 100% bright field with the SMfit spotmeter.

NOTE **Do not exert any pressure on the LCD display of the monitor during the measurement with the SMfit spotmeter.**

- Switch off the ambient light sensor, if present.

Color monitors

	Luminance setpoint:	Factory Measured luminance:	Place of use Measured luminance:
Left monitor **100% bright field**	200 cd/m2 +/- 20 cd/m2 *1 *2	..... cd/m2	..... cd/m2
Right monitor **100% bright field**	200 cd/m2 +/- 20 cd/m2 *1 *2	..... cd/m2	..... cd/m2
*1 Tolerance specifications in the delivery state. *2 SIEMENS TFT Display, Type DSC 1904: Allowable tolerance in delivery state: +20 / -40 cd/m^2 The monitor is worn out when the maximum adjustable luminance has fallen below 120 cd/m^2.			
Remarks:			

Monochrome monitors

	Luminance setpoint:	Factory Measured luminance:	Place of use Measured luminance:
Left monitor **100% bright field**	410 cd/m2 +/- 20 cd/m2 *1	..... cd/m2	..... cd/m2
Right monitor **100% bright field**	410 cd/m2 +/- 20 cd/m2 *1	..... cd/m2	..... cd/m2
*1 Tolerance specifications in the delivery state. The monitor is worn out when the maximum adjustable luminance has fallen below 350 cd/m^2.			
Remarks:			

Monitor contrast

- Load the SMPTE calibration test image (ASPIA test images).
- Switch off the ambient light sensor of the monitor, if present.
- Measure the 0% dark field with the SMfit spotmeter.

NOTE

Do not exert any pressure on the LCD display of the monitor during the measurement with the SMfit spotmeter.

- Use the luminance measured previously in the "Monitor brightness" section in the 100% bright field to calculate the contrast.
- Calculate the contrast as follows and enter it in the table:

$$\text{Contrast} = \frac{\text{Monitor, measured luminance in 100\% bright field}}{\text{Monitor, measured luminance in 0\% dark field}}$$

Color monitors

	Setpoints	Factory	Place of use
Left monitor 0% dark field	Luminance setpoint: ≤1 cd/m2	Measured luminance: cd/m2	Measured luminance: cd/m2
Left monitor Contrast	Contrast setpoint: ≥ 200 *1	Calculated contrast:	Calculated contrast: .....
Right monitor 0% dark field	Luminance setpoint: ≤1 cd/m2	Measured luminance: cd/m2	Measured luminance: cd/m2
Right monitor Contrast	Contrast setpoint: ≥ 200 *1	Calculated contrast:	Calculated contrast: .....

*1 SIEMENS TFT Display, Type DSC 1904: Allowable contrast: ≥ 180

Monochrome monitors

	Setpoints	Factory	Place of use
Left monitor 0% dark field	Luminance setpoint: ≤1 cd/m2	Measured luminance: cd/m2	Measured luminance: cd/m2
Left monitor Contrast	Contrast setpoint: ≥ 350	Calculated contrast:	Calculated contrast: .....
Right monitor 0% dark field	Luminance setpoint: ≤1 cd/m2	Measured luminance: cd/m2	Measured luminance: cd/m2
Right monitor Contrast	Contrast setpoint: ≥ 350	Calculated contrast:	Calculated contrast: .....

Visual evaluation of the SMPTE calibration test image

- Display the SMPTE calibration test image on both monitors.
- Visually evaluate the SMPTE calibration test image on both monitors.

Factory	Left monitor	Right monitor
All gray values are clearly visible:	❒ Yes / ❒ No	❒ Yes / ❒ No
The 5% field and the 95% field are visible:	❒ Yes / ❒ No	❒ Yes / ❒ No

Place of use	Left monitor	Right monitor
All gray values are clearly visible:	❒ Yes / ❒ No	❒ Yes / ❒ No
The 5% field and the 95% field are visible:	❒ Yes / ❒ No	❒ Yes / ❒ No

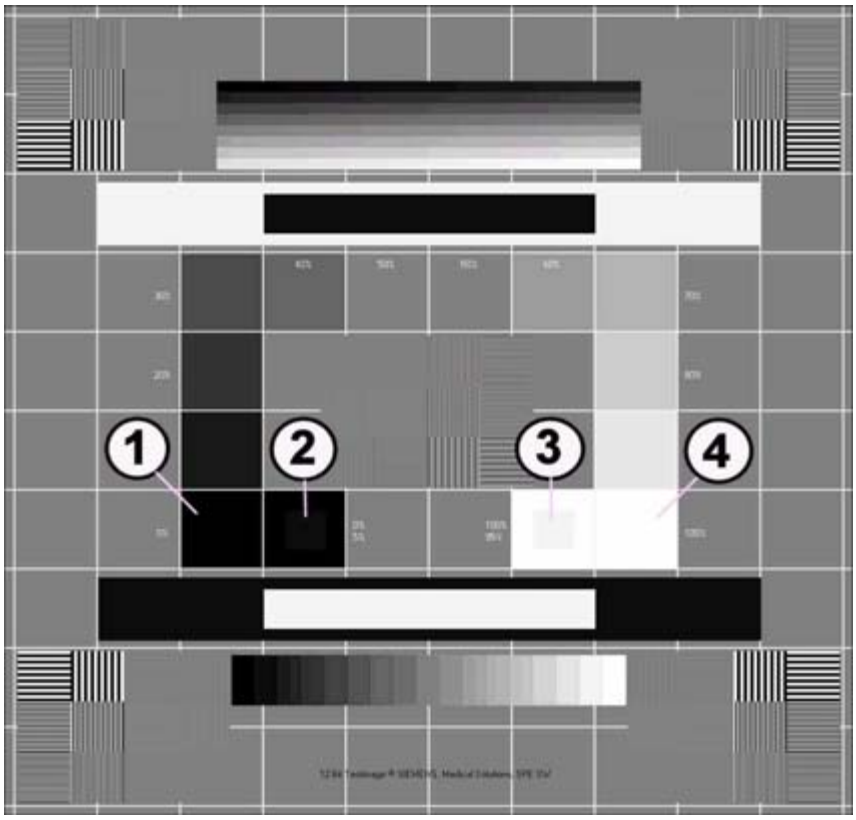

Fig. 2: SMPTE calibration test image

Pos. 1 0% field

Pos. 2 5% field

Pos. 3 95% field

Pos. 4 100% field

Prerequisites

- The indicated exam sets must be selected for fluoroscopy, pulsed fluoroscopy, DCM, and DR. See the "Loading the exam sets relevant for the IQ test" section.
- Attach a 2.1mm Cu precision X-ray filter for prefiltration in the area of the radiation exit.
- All exposures are pre-contrast images (no additional object in the beam path).

Evaluation

NOTE

The specified exam sets must be used for the checks.

The activation of the exam sets is described in the introduction chapter.

ADR control curve for the fluoroscopy mode

- Select fluoro.
- Select I.I. full format.
- Select the "General, All region, SERVICE_Q_S2" exam set.
- Select medium dose level.

- Radiation on.
- Read off the kV and mA values displayed on the operating panel.
- Radiation off.
- Enter the values in table 1, line S2.
- Fluoro and I.I. full format remain selected.
- Select the "General, All region, SERVICE_Q_HC2" exam set.
- Select medium dose level.

- Radiation on.
- Read off the kV and mA values displayed on the operating panel.
- Radiation off.
- Enter the values in table 1, line HC2.
- The actual values documented at the factory must be obtained again at the place of use. Admissible deviations: Tube voltage (kV) ± 1 kV, tube current (mA) ± 10%.

Tab. 6

Cont. fluoro ADR control curves (included in the exam set)	Setpoints		Actual values			
			Factory		Place of use	
	kV	mA	kV	mA	kV	mA
S2 (General, All region, SERVICE_Q_S2, Mid Dose)	66 - 72	1.0 - 1.2				
HC 2 (General, All region, SERVICE_Q_HC2, Mid Dose)	62 - 64	2.5 - 3.7				

ADR control curves for the pulsed fluoroscopy mode

- Select pulsed fluoro.
- Select I.I. full format.
- Select the "General, All region, SERVICE_Q_S2" exam set.
- Select medium dose level.
- Pulse frequency 8 (7.5) per second

- Radiation on.
- Read off the kV and mA values displayed on the monitor.
- Radiation off.
- Enter the values in table 2, line S2 / 8 fps.
- Pulsed fluoro and I.I. full format remain selected.
- Select the "General, All region, SERVICE_Q_HC2" exam set.
- Select medium dose level.

- Radiation on.
- Read off the kV and mA values displayed on the monitor.
- Radiation off.
- Enter the values in table 2, line HC2 / 8 fps.
- The actual values documented at the factory must be obtained again at the place of use. Admissible deviations: Tube voltage (kV) ± 1 kV, tube current (mA) ± 10%.

Tab. 7

Pulsed fluoro ADR control curves (included in the exam set)	**Setpoints**		**Actual values**			
			Factory		**Place of use**	
	kV	mA	kV	mA	kV	mA
S2 / 8 Fps (General, All region, SERVICE_Q_S2, Mid Dose)	64 - 70	14.3 - 18.6				
HC2 / 8 Fps (General, All region, SERVICE_Q_HC2, Mid Dose)	60 - 63	36.0 - 56.3				

ADR control curve for the DCM mode

DCM option present: If no: The "ADR control curve for the DCM mode" section does not apply.	yes	No

- Select DCM.
- Select I.I. full format.
- Select the "General, All region, SERVICE_Res_HC2" exam set.
- Pulse frequency 8 (7.5) per second
- Select high dose.

- Radiation on.
- Read off the kV and mA values displayed on the monitor.
- Radiation off.
- Enter the values in table 2, line HC2 / 8 fps.
- The actual values documented at the factory must be obtained again at the place of use. Admissible deviations: Tube voltage (kV) ± 1 kV, tube current (mA) ± 10%.

Tab. 8

DCM **ADR control curve** **(included in the exam set)**	**Setpoints**		**Actual values**			
			Factory		**Place of use**	
	kV	mA	kV	mA	kV	mA
HC2 / 8 Fps (General, All region, SERVICE_Q_HC2, High Dose)	65 - 69	173 - 250				

ADR control curves for the DR mode

- Select DR.
- Select I.I. full format.
- Select the "General, All region, SERVICE_Q_HC2" exam set.
- Select medium dose level.

- Radiation on.
- Read off the kV and mAs values displayed on the monitor.
- Radiation off.
- Enter the values in table 3, line DR 1000W.
- The actual values documented at the factory must be obtained again at the place of use. Admissible deviations: Tube voltage (kV) ± 1 kV, tube current (mA) ± 10%.

Tab. 9

DR takeover	Setpoints		Actual values			
			Factory		Place of use	
	kV	mAs	kV	mAs	kV	mAs
DR 1000W K=16 (General, All region, SERVICE_Q_HC2, Mid Dose)	62 - 65	4.2 - 6.8				

Checking the resolution and minimum contrast

Requirements

- Use resolution test type 41 (factory and place of use).
- Attach the resolution test directly to the I.I. grid in the center of the I.I. at an angle of approx. 90 degrees with respect to the grid lines (45 degrees with respect to the CCD structure).
- In the factory: Place a 25 mm AL measuring stand on the I.I.
- Place of use: If the 25 mm AL measuring stand (with 0.4 mm recess) is present, attach it near the I.I., otherwise attach the 17 µm Cu strip directly to the I.I. grid next to the resolution test. Additionally, place a 1.2 mm Cu filter in the beam path. Fading at the I.I. edge can be eliminated via collimation.
- Select the indicated operating mode (fluoro/DCM/DR (1000W)) and the respective I.I. format according to the "Resolution" table.
- Additionally, select the indicated exam set after selecting the appropriate operating mode (fluoro/DCM/DR(1000W)).

- Radiation "on".
- Show the resolution test phantom.
- Set the monitor contrast to optimum resolution.
- Set the edge enhancement to optimum resolution.
- Radiation OFF.

Evaluation of resolution and minimum contrast

DCM option present: If no: Checking the resolution and minimum contrast during DCM mode does not apply.	Yes	No

- Determine the resolution of the LIH image and enter it in the Resolution table.

NOTE

Use the electronic zoom function and windowing in the Viewing task card if necessary.

Tab. 10 Resolution

Operating mode (Exam set)	I.I. format	I.I. 33 setpoints for resolution	Actual resolution values [LP/mm]	
			Factory	Place of use
DL (HC2) (General, All region, SERVICE_Q_HC2, Mid Dose)	Full format	≥ 1.4 LP/mm		
DL (HC2) (General, All region, SERVICE_Q_HC2, Mid Dose)	Zoom 1	≥ 1.8 LP/mm		
DL (HC2) (General, All region, SERVICE_Q_HC2, Mid Dose)	Zoom 2	≥ 2.2 LP/mm		
DL (HC2) (General, All region, SERVICE_Q_HC2, Mid Dose)	Zoom 3	≥ 2.5 LP/mm		
DCM (HC2) (General, All region, SERVICE_Q_HC2, Mid Dose)	Full format	≥ 1.2 LP/mm		
DCM (HC2) (General, All region, SERVICE_Q_HC2, Mid Dose)	Zoom 1	≥ 1.6 LP/mm		
DCM (HC2) (General, All region, SERVICE_Q_HC2, Mid Dose)	Zoom 2	≥ 2.0 LP/mm		

Operating mode (Exam set)	I.I. format	I.I. 33 setpoints for resolution	Actual resolution values [LP/mm]	
			Factory	Place of use
DCM (HC2) (General, All region, SERVICE_Q_HC2, Mid Dose)	Zoom 3	≥ 2.2 LP/mm		
DR (1000W) (General, All region, SERVICE_Q_HC2, Mid Dose)	Full format	≥ 1.4 LP/mm		
DR (1000W) (General, All region, SERVICE_Q_HC2, Mid Dose)	Zoom 1	≥ 1.8 LP/mm		
DR (1000W) (General, All region, SERVICE_Q_HC2, Mid Dose)	Zoom 2	≥ 2.2 LP/mm		
DR (1000W) (General, All region, SERVICE_Q_HC2, Mid Dose)	Zoom 3	≥ 2.5 LP/mm		

- Also check the minimum contrast during the resolution test and enter it in the minimum contrast table.

Is the minimum contrast visible?

Tab. 11 Minimum contrast

Factory					Place of use				
Full format		Yes		No	Full format		Yes		No
Zoom 1		Yes		No	Zoom 1		Yes		No
Zoom 2		Yes		No	Zoom 2		Yes		No
Zoom 3		Yes		No	Zoom 3		Yes		No

Evaluation of resolution without prefiltration

- Subsequently remove the 25 mm Al or 1.2 mm Cu prefilter.
- Collimate to the resolution test.

- Perform the resolution test for DR again without prefilter as above.

Tab. 12 Evaluation of resolution without prefiltration

Operating mode	I.I. format	Required values Resolution	Actual value Resolution [LP/mm]	
			Factory	Place of use
		23 cm I.I.	Monitor 1	Monitor 1
DR (1000W) (General, All region, SERVICE_Q_HC2, Mid Dose)	Full format	≥ 1.6 LP/mm		
DR (1000W) (General, All region, SERVICE_Q_HC2, Mid Dose)	Zoom 1	≥ 2.0 LP/mm		
DR (1000W) (General, All region, SERVICE_Q_HC2, Mid Dose)	Zoom 2	≥ 2.5 LP/mm		
DR (1000W) (General, All region, SERVICE_Q_HC2, Mid Dose)	Zoom 3	≥ 3.1 LP/mm		

Dynamic test

SUBTRACTION option present: If no: The sections Capillary visibility test during subtraction, Capillary visibility test for roadmap, and Pixelshift function do not apply.	Yes	No

NOTE

The dynamic test in conjunction with the plexi capillary test is used to detect small contrast differences.

Capillary visibility test during fluoroscopy

Measurement setup

- Remove the 1.2mm Cu precision X-ray filter from the beam path.
- Place the dynamic test without holder, with heart contour diaphragm and plexi capillary test on an X-ray-compatible table. The plexi capillaries are close to the I.I.

Prerequisites

- Vollformat anwählen.
- ExamSet “General, All region, SERVICE_Q_HC2” auswählen.
- Set the dose rate level to "High".
- Set a distance from the I.I. to the dynamic test that allows for the image field to be covered completely.
- Set noise reduction to high. (The LED in button 11 of the control console (heart button) does not light up).
- Kantenanhebung auf niedrigste Stufe einstellen (Taste).
- Select linear LUT (LUT G1)

Evaluation of the monitor image

- Switch radiation on and evaluate the live image during radiation.
- Check off non-visible plexi capillaries in (Fig. 3 / p. 32) (from left to right 2L - 1 - 5R).

Setpoints

➪ The plexi capillaries not identified in (1 /Fig. 3 / p. 32) must be visible.

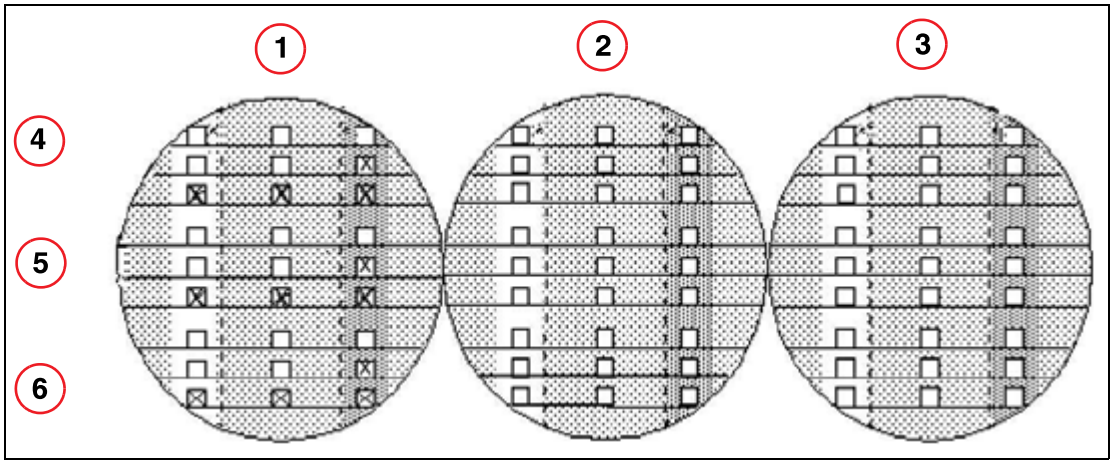

Fig. 3: Monitor image

Pos. 1	Target value
Pos. 2	Factory
Pos. 3	Place of use
Pos. 4	Group 3-mm wide
Pos. 5	Group 2-mm wide
Pos. 6	Group 1-mm wide

Capillary visibility test during subtraction

Measurement setup

- Place the dynamic test without holder, with heart contour diaphragm and plexi capillary test on an X-ray-compatible table. The plexi capillaries are close to the I.I.
- Mechanically clamp the plexi capillary test so that the plexi capillaries can be moved by the rubber ball during the subtraction exposure.

Prerequisites

- Vollformat anwählen.
- ExamSet “General, All region, SERVICE_Q_HC2” auswählen.
- Die Dosisleistungsstufe “High” anwählen.
- Set a distance from the I.I. to the dynamic test that allows for the image field to be covered completely.
- Select subtraction.
  - ➪ SUB LUT 3MH wird angewählt (Voreinstellung).
- Kantenanhebung auf niedrigste Stufe einstellen (Taste)

Trigger subtraction

- Switch radiation on.
  - ➪ After 3 seconds of radiation, the mask is set automatically.
- Then cause the plexi capillary test to move by squeezing the rubber ball.
- After another 3 seconds, switch the radiation off.

Evaluation of the capillary visibility

- Use the mouse in the scrollbar to scroll back in the viewing task card to where the white and black capillaries are best visible (2 to 3 images).

NOTE

For improved visibility,

SUB LUT 4MH can also be selected as needed.

NOTE

Do not evaluate the first white line.

Start the evaluation with the first black line.

- Check off non-visible black plexi capillaries in the "Subtraction, black lines" table (from left to right 2L - 1 - 5R).
- Check off non-visible white plexi capillaries in the "Subtraction, white lines" table (from left to right 2L - 1 - 5R).

Setpoints

- ➪ The black plexi capillaries not identified in the "Setpoints" column of the "Subtraction, black lines" table must be visible.
- ➪ The white plexi capillaries not identified in the "Setpoints" column of the "Subtraction, white lines" table must be visible.

Tab. 13 Subtraction, black lines

	Setpoints			Factory			Place of use			
	2L	**1**	**5R**	**2L**	**1**	**5R**	**2L**	**1**	**5R**	**Group**
Black										Top Group 3 mm Width
Black			**X**							
Black	**X**	**X**	**X**							
Black										Middle Group 2 mm Width
Black			**X**							
Black	**X**	**X**	**X**							

	Setpoints			Factory			Place of use			
	2L	**1**	**5R**	**2L**	**1**	**5R**	**2L**	**1**	**5R**	**Group**
Black										Bottom Group 1 mm Width
Black			**X**							
Black	**X**	**X**	**X**							

Tab. 14 Subtraction, white lines

	Setpoints			Factory			Place of use			
	2L	**1**	**5R**	**2L**	**1**	**5R**	**2L**	**1**	**5R**	**Group**
White										Top Group 3 mm Width
White			**X**							
White	**X**	**X**	**X**							
White										Middle Group 2 mm Width
White			**X**							
White	**X**	**X**	**X**							
White										Bottom Group 1 mm Width
White			**X**							
White	**X**	**X**	**X**							

Evaluation of visual brightness impression

- On monitor A, evaluate the white, 3-mm capillary line in fields 2L, 1 and 5R. There must not be any noticeable difference in brightness in the fields.

No noticeable difference in brightness visible in fields 2L, 1 and 5R:	**Factory**		**Place of use**	
	❑Yes	❑ No	❑Yes	❑ No

Capillary visibility test for roadmap

Measurement setup

- Place the dynamic test without holder, with heart contour diaphragm and plexi capillary test on an X-ray-compatible table. The plexi capillaries are close to the I.I.
- Mechanically clamp the plexi capillary test so that the plexi capillaries can be moved by the rubber ball during the subtraction exposure.

Prerequisites

- Vollformat anwählen.
- ExamSet “General, All region, SERVICE_Res_HC2” auswählen.
- Die Dosisleistungsstufe “Mid” anwählen.
- Set a distance from the I.I. to the dynamic test that allows for the image field to be covered completely.
- Select roadmap.
- Kantenanhebung auf niedrigste Stufe einstellen (Taste).
- Select SUB LUT 3MH (pre-setting)

Start roadmap

- Switch radiation on (phase A).
  - ➪ After 3 seconds of radiation, the mask is set automatically (phase B).
- Do **not** move the plexi capillary test (rubber ball).
- After another 3 seconds, switch the radiation off.

- Switch radiation on again (phase C).
  - ➪ The LUT must have switched over to SUB LUT 3R (pre-setting). If SUB LUT 3MH has correctly switched over to SUB LUT 3R, the image background changes from light to dark.
- Move the plexi capillary test by squeezing the rubber ball.
- Radiation remains switched on during the evaluation.

Evaluation of the capillary visibility

- Radiation remains switched on during the evaluation.

NOTE	**Do not evaluate the first white line.** **Start the evaluation with the first black line.**

- Check off non-visible black plexi capillaries in the "Roadmap, black lines" table (from left to right 2L - 1 - 5R).
- Check off non-visible white plexi capillaries in the "Roadmap, white lines" table (from left to right 2L - 1 - 5R).
- After the capillary visibility is evaluated, switch radiation off.

Setpoints

- ➪ The black plexi capillaries not identified in the "Setpoints" column of the "Roadmap, black lines" table must be visible.
- ➪ The white plexi capillaries not identified in the "Setpoints" column of the "Roadmap, white lines" table must be visible.

Tab. 15 oadmap, Schwarze LInien

	Setpoints			Factory			Place of use			
	2L	**1**	**5R**	**2L**	**1**	**5R**	**2L**	**1**	**5R**	**Group**
Black										Top Group 3 mm Width
Black		**X**	**X**							
Black	**X**	**X**	**X**							
Black										Middle Group 2 mm Width
Black		**X**	**X**							
Black	**X**	**X**	**X**							
Black										Bottom Group 1 mm Width
Black		**X**	**X**							
Black	**X**	**X**	**X**							

Tab. 16 Roadmap, white lines

	Setpoints			Factory			Place of use			
	2L	1	5R	2L	1	5R	2L	1	5R	Group
White										Top Group 3 mm Width
White		X	X							
White	X	X	X							
White										Middle Group 2 mm Width
White		X	X							
White	X	X	X							
White										Bottom Group 1 mm Width
White		X	X							
White	X	X	X							

Evaluation of LUT change from phase B to phase C

- As described in the "Start roadmap" section, SUB LUT 3R must automatically be selected when changing to phase C.

	Factory		Place of use	
LUT changed when changing from phase B to phase C:	❑Yes	❑ No	❑Yes	❑ No

Pixelshift function

Prerequisite

The subtraction image from the roadmap test is present.

- Select the roadmap image in the Viewer.
- Select pixelshift in the SUB task card.

Evaluation

- Using the arrow tool, move the mask successively in all directions:
  - ➪ Apart from the black and white edge strips, no artifacts may occur.

- Using the Auto Pixelshift tool, select a location.
  ➪ In this location the shifted mask must return to artifact-free superimposition.

	Factory				Place of use			
Pixelshift function ok?	❒	yes	❒	No	❒	Yes	❒	No

Edge enhancement, contrast enhancement, and object movements

NOTE

Only perform edge enhancement, LUT selection change, and motion unsharpness at the factory.

Edge enhancement

Requirements

- Place the dynamic test without holder, with heart contour diaphragm and plexi capillary test, on the I.I. input screen. The plexi capillaries are close to the I.I.
- Select the "General, All region, SERVICE_Q_HC2" exam set.
- Select medium dose level.
- Set edge enhancement to the lowest level.

- Release fluoroscopy briefly.
  - ➪ Use the LIH image to evaluate the edge enhancement.

Evaluation of the monitor image

- Activate the button for selecting edge enhancement on the control console several times.
  - ➪ The individual edge enhancement levels (20%, 40%, ...) are selected one after another.
- Evaluate the edge enhancement function.

	Factory			
Function control of edge enhancement OK? => The bright-dark transitions are clearly visible when a higher percentage edge enhancement level is selected.	❒	Yes	❒	No

LUT selection change

Requirements

- Place the dynamic test without holder, with heart contour diaphragm and plexi capillary test, on the I.I. input screen. The plexi capillaries are close to the I.I.
- Select the "General, All region, SERVICE_Q_HC2" exam set.
- Select medium dose level.
- Set edge enhancement to the lowest level.

- Release fluoroscopy briefly.
  - ➪ Use the LIH image to evaluate the LUT selection change.

Evaluation of the monitor image

- Activate the LUT selection change button.
  - ➪ The image contrast changes.
- Evaluate the LUT selection change function.

	Factory			
LUT selection change function OK?	❒	Yes	❒	No

Motion unsharpness

DCM option present: If no: Motion unsharpness section does not apply.	Yes	No

Requirements

- Remove the dynamic test without holder, with heart contour diaphragm and plexi capillary test, from the I.I. input screen and place on a separate surface (e.g. table).
- Additionally, place a screwdriver in the center of the dynamic test.
- Position the C-arm with respect to the separate surface so that the dynamic test is over or under the I.I. input screen. The plexi capillaries are close to the I.I.

NOTE

If no suitable surface is available, the dynamic test with heart contour diaphragm and plexi capillary test can also be placed directly on the I.I. input screen.

An X-ray-absorbing object (e.g. long aluminum rod or the like) must by moved over the dynamic test in the beam path during radiation.

Pay attention to radiation protection!

- Select the "General, All region, SERVICE_Q_HC2" exam set.
- Select medium dose level.

Evaluation of the monitor image

- Fluoroscopy on.
- Move the C-arm horizontally during fluoroscopy.
  - ➪ A smearing effect is clearly visible on the image during movement of the C-arm with respect to the capillary test.
- Radiation off.

- Select the DCM operating mode.
  - ➪ The "General, All region, SERVICE_Q_HC2" exam set remains selected.
- Select the maximum pulse frequency.

- Radiation (DCM) on.
- Move the C-arm horizontally during DCM.
  - ➪ The object is depicted in sharp focus but in multiple images when the C-arm is moved with respect to the capillary test.
- Radiation "off".
- Evaluate the motion unsharpness test.
- Remove the screwdriver that was placed there before.

	Factory			
FL, DCM functions OK?	❒	Yes	❒	No

Comments

_____
_____
_____
_____
_____

NOTE **Perform only in the factory.**

The following controls are active for the specified prefiltration.

Automatic dose rate control (ADR)	with approximately 9 to 11 mm Cu and dynamic test in the beam path
Automatic TV iris collimator control (AIR)	with approximately 11 to 13 mm Cu and dynamic test in the beam path

The test is used to test the functioning of these controls.

Requirements

- Both monitors must be set to give approximately the same brightness and contrast impression (synchronism) (LUT, brightness and contrast setting).

Preparations

- Attach the dynamic test without holder and plexi capillary test, but with heart contour diaphragm, to the I.I.:
- Select the "General, All region, SERVICE_Q_HC2" exam set.
- Select medium dose level.
- Select the fluoro operating mode.
- Switch the I.I. to full format.
- Completely open the collimator.
- Prefilter with Cu until 120 kV to 124 kV are displayed. To do this, switch on fluoroscopy briefly (approx. 9 mm to 11 mm Cu necessary).
  - ➪ Automatic dose rate control (ADR) is active.

- Radiation on.
- Select linear contrast LUT. (LUT_Linear)
- Evaluate the brightness of the fluoroscopy image.
- Radiation off.
- Save the LIH image and display it on the reference monitor.

TV iris collimator control

- Additionally, attach 2.1 mm Cu to the radiation exit.

- Radiation on.
  - ➪ Generator limit 125 kV/4.3 mA must be reached.
  - ➪ The automatic TV iris collimator control (AIR) is active.
- Select linear contrast LUT. (LUT_Linear)
- Evaluate the brightness of the fluoroscopy image.
- Radiation off.
- Save the LIH image.

- Display both images on both monitors.
  - ➪ Display the image saved during active ADR on the right monitor.
  - ➪ Display the image saved during active AIR on the left monitor.
  - ➪ Both images are displayed with the linear LUT (LUT_Linear).
- Evaluate the brightness impression of the fluoroscopic image generated during active AIR and compare it to that of the reference image generated during active ADR.
  - ➪ The brightness impression should be approximately the same.

Evaluation

	Factory	
Same brightness impression?	❑Yes	❑No

Digital preprocessing

NOTE	**Perform only in the factory.**

Checking camera rotation

Requirements

- Place the dynamic test without holder, with heart contour diaphragm and plexi capillary test, on the I.I. input screen.
- Select the "General, All region, SERVICE_Q_HC2" exam set.
- Select medium dose level.
- Set the monitor contrast to linear.
- Edge enhancement = on (10%)

Test sequence

- Set the specified camera rotation angles.
- Record an image for each one.
- Evaluate the image with respect to artifacts.

Angles to be set (to be set on the C-arm control panel):

1°; 2°; 5°; 22°; 85°; 88°; 89°; 90°; 180°; 270°

Evaluation

Rotation function OK?	Yes	No

Vignetting compensation

Requirements

- Remove the dynamic test.
- Set the monitor contrast to linear.
- Attach a 2.1 mm Cu prefilter close to the tube.
- Select the "General, All region, SERVICE_Q_HC2" exam set.
- Select medium dose level.

Test sequence

- Release fluoroscopy briefly and save the image via the ATB button.

- Select local service (menu: <Options>-<Service>-<Local Service>).
  - ➪ When the local service window is open and the measurement function is selected in the Viewing task card, the corresponding brightness value (min/max/mean/SD%) can be displayed by selecting an image region with the mouse.
- Minimize the local service window or move it to the right monitor.
- Select the previously saved image in the viewer.
- In the Tools menu bar of the imaging system, select **Measure ---> Rectangle** ↵.
- Select the 5 fields according to the "measuring field" image. To do this, place the mouse pointer on a corner of the field to be measured and select the field according to the "display values" image while pressing the left mouse button.
  - ➪ The brightness data is displayed for every marked field.
- Read off the average brightness value (mean) for every field.
  - ➪ Divide the average (mean) of each of the fields at the edge by the average (mean) of the middle field and then multiply each result by 100 (brightness outside to brightness middle (in %) --> (Mean X / (Mean 1/ 100))

Fig. 4: Measuring field

	Center scan field	Left measurement field [%]	Right measurement field [%]	Upper measurement field [%]	Lower measure-ment field [%]
Brightness value	_____	_____	_____	_____	_____
Brightness in %	n.a.	_____	_____	_____	_____

Image disturbances (artifacts)

- Check off all image disturbances determined during settings and IQ tests in the table in the IQ measuring protocol.
- If image disturbances are detected that are not listed in the table, describe them under "Other disturbances".
- Three assessment numbers indicating the extent of the disturbance are provided for each assessment of the relevant disturbance.

Definition of the assessment numbers

1 = No disturbances and artifacts were detected during start-up.

2 = Minor disturbances, artifacts occurred sporadically during start-up. The cause could not be localized and the "error" could not be corrected. The disturbances scarcely affect the good overall image impression, and the ability to make a medical diagnosis from the images is absolutely not impaired. Therefore, the artifacts are tolerable.

3 = During start-up, more frequent or stronger disturbances/artifacts occurred that disturb the overall impression of the image or impair the ability of the images to be diagnosed medically and are therefore no longer tolerable. The system must not be shipped or handed over to the operator in this condition.

Description of the artifacts

- **Hum:**

  Inconsistencies resulting from electromagnetic interference in the imaging systems are unattractive and disturbing. Depending on the nature of the disturbance, they can considerably impair the ability of the images to be evaluated and should ideally not occur at all. They are tolerable only to a very slight degree. Hum disturbances are visible as sporadic, horizontal light-dark patterns in the image; they are temporary and are not limited to a specific location.

- **Interference stripes:**

  Very high-frequency electromagnetic radiation is visible in the image as light or dark, sometimes very short, horizontal lines (temporary). Interference stripes that are caused by dirt on optically effective surfaces must also be recorded here. They are limited to a specific location and are not temporary. Interference stripes are barely tolerable.

- **Ghost images:**

  These are object contours that are usually offset to one side and appear double. They are caused by reflections in poorly adapted, long video cables. Clearly visible ghost images are not tolerable.

- **Background structures** are permanent, grid-shaped patterns, primarily in dark image sections, that are also called "fixed noise".

- **Pixel errors** are image pixels without image information. They are visible on the monitor as dark or light pixel-size dots. There are tolerable and intolerable pixel errors. The TV camera is inspected very precisely in the test area for pixel errors and only TV cameras with pixel errors corresponding to an internal specification according to type and number are provided to customers. These tolerable pixel errors must be documented in the IQ measuring protocol.

Evaluation of the image disturbances

Setpoint for assessment of the disturbance: Only 1 and 2 are allowed.

	Factory			Place of use		
Nature of the disturbance, artifact	**Assessment of the disturbance *1**			**Assessment of the disturbance *1**		
	1	2	3	1	2	3
Hum						
Interference stripes						
Ghost images (reflections)						
Background structures						
Pixel errors ***2**						

Other disturbances:

_____

_____

_____

Comments:

_____

_____

_____

_____

_____

Remark: Image disturbance assessments must be recorded at the place of use.

***1** Assessment of the disturbances

1 = No disturbances, artifacts

2 = Slight disturbances, artifacts

3 = Intolerable disturbances, artifacts

***2** State the number and position of pixel errors under Remarks.

Local Printer - Sony UPD970 / UPD 990

NOTE

If a hardcopy camera is to be connected, see "General Hardcopy Information", SPR2-310.814.25... (CB-DOC).

Local printer available? If yes: camera type ..... If no: chapter not applicable.	❑Yes	❑No

Function Check

NOTE

The Analog/Digital switch on printer UPD 970/990 has to be set to "Digital".

- The local printer has to be connected and ready to operate.
- Open local service so that the service patient is displayed in the Patient Browser.

  ➪

Requirements

- Select the service patient in the browser, load the SMPTE test image in the Viewer, and print it at the local printer.

Evaluation

- The 5% and 95% fields on the printed SMPTE test image should still be discernible.

  ➪ If necessary, adjust the brightness / contrast using the control dials at the front of the printer, and repeat the test.

	Place of use	
Test OK?	❑ Yes	❑ No

Remarks:

_____

_____

_____

_____

Customer-specific organ programs (exam sets)

NOTE

Only at the place of use, only after changes to the organ programs (examination sets) as requested by the customer

No organ programs were changed during start-up. If "yes", do not perform the check of the newly programmed ADR control characteristics.	❒ Yes	❒ No	Date _____	Signature _____

Checking newly programmed ADR control characteristics

NOTE

The ADR control characteristics programmed by default were already checked in the "Checking the ADR control characteristics" section.

NOTE

The check of newly programmed ADR control characteristics facilitates testing of the ADR control characteristics during subsequent maintenance work.

During start-up, the determined values are entered in the "Setpoints" column of the "Changed organ programs" table.

During later checks, the determined values are entered in the "Actual values" column.

As a result, a comparison of the start-up values and the subsequently determined values is ensured.

Preparations

- Select fluoroscopy.
- Attach a 2.1mm Cu precision X-ray filter for prefiltration in the area of the radiation outlet.
- Select the organ program (exam set) with the changed ADR control characteristic.
- Enter the name of the organ program (exam set) with the changed ADR control characteristic in the "Organ program" column of the "Changed organ programs" table.
- Enter the name of the programmed ADR control characteristic in the "ADR control characteristic" column of the "Changed organ program" table. Use the name specified in the operating instructions.

Evaluation

- Leave the programmed dose rate level and enter it in the "Dose level" column of the "Changed organ programs" table.
- Radiation on.
- Read off the kV and mA values displayed on the control panel during start-up and enter them in the "Setpoints" column of the "Changed organ programs" table.
- Read off the kV and mA values displayed on the control panel during subsequent checks and enter them in the "Actual values" column of the "Changed organ programs" table.
- If additional organ programs with changed control characteristics are programmed, repeat the above-described procedure.
- Enter n.a. in all unused table rows.

Tab. 17 Changed organ programs

Organ program	ADR control curve	Dose level	Setpoints (Start-up)		Actual values (Maintenance)	
n.a.	n.a.	n.a.	kV	mA	kV	mA

Protective conductor test

- The image quality quick test can normally be performed without opening the covers. The protective conductor test is not necessary.
- However, if the ARCADIS Avantic covers were removed, the protective conductor test must be performed according to ARTD-002.731.17....

⚠WARNING

Danger of injury, death, or material damage.

Non-compliance can lead to death, injury, or material damage.

Please note:

- ➪ **The product-specific safety information in the start-up instructions and system service documentation**
- ➪ **The general safety information in TD00-000.860.01... and**
- ➪ **The safety information in accordance with ARTD Part 2.**

All chapters:	Editorially revised,

Checking the image position

Requirements

Place a long, thin, straight object (e.g. wire solder bent straight) near the I.I. -- at an exact right angle to the C-arm orientation.

Place a second object next to it -- for direction determination (see (Fig. 5 / p. 55)).

Fig. 5: Image position
Pos. 1 C_arm_alignment

The rotation angle of the image on the display of the basic unit must be 0.

If necessary, set the angle to 0.

Record an image (see (Fig. 6 / p. 56)).

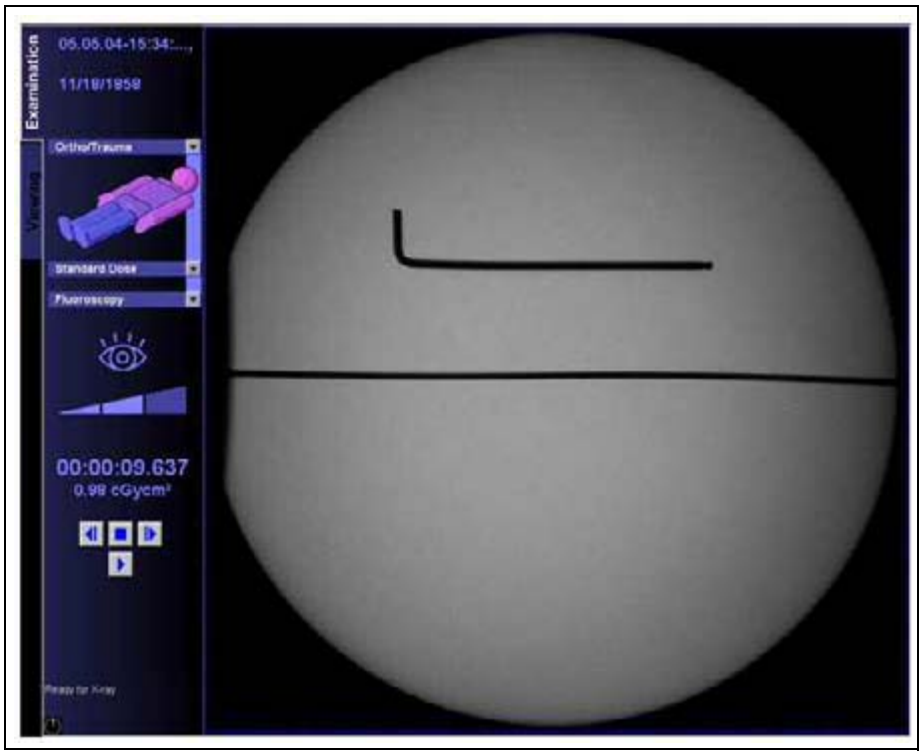

Fig. 6: Results image

Evaluation

The object must appear on the screen in an exactly horizontal position.

	Factory				Place of use			
Image position OK?	❒	Yes	❒	No	❒	Yes	❒	No